National Aeronautics and
Space Administration
Goddard Space Flight Center
Greenbelt, MD 20771

Reply to Attn of: 490

NASA Headquarters
Attn: Science Mission Directorate/Dr. Cleave

FROM: Goddard Space Flight Center/Director
Langley Research Center/Director

SUBJECT: CALIPSO Mission Readiness

On August 26, 2005, the Integrated Program Management Council (IPMC) held the CALIPSO Mission Readiness Review (MRR) at the NASA Goddard Space Flight Center (GSFC). The IPMC is composed of members from the Program Management Councils of both GSFC and the NASA Langley Research Center (LaRC) and it is co-chaired by the GSFC Deputy Center Director and the LaRC Center Director. Senior officials from the Centre National d'Etudes Spatiales (CNES) were also present.

The readiness of the flight system, operations, the launch vehicle, science data processing, and the education and public outreach plans was reviewed. Both the payload and the platform flight hardware and software are ready for launch. All satellite end-to-end tests were successful and there are no open technical issues. The capability to support operations was confirmed at the successful Operations Readiness Review (ORR) held on August 17-19, 2005, in Toulouse, France. The ORR Board unanimously voted to proceed with the launch and complimented the CALIPSO Operations Team on how well the French and U.S. members are working together. All of the operational documentation is in place. The science data processing is ready, the necessary data products are completed, and the validation plans are in place. The education and public outreach plans are ready to support the launch. The brochure, fact sheets, displays, and several features for the NASA portal are all complete. After a short discussion, the IPMC voted unanimously to proceed with the launch.

The CALIPSO Integrated Independent Review Team (IIRT) is co-chaired by Michel Arnaud (CNES), Mark Goans (GSFC), and Michael Gilbert (LaRC). This IIRT has attended 23 previous CALIPSO reviews dating back to December 1999. During the MRR, the co-chairs reviewed the assigned actions from recent reviews. All are now closed. They reviewed the status of each waiver and found them acceptable. Looking back, they found persistent shortcomings in the Systems Management, Safety, and Mission Assurance but felt that these were improving and that the comprehensive list of residual risks effectively encompassed these shortcomings. The IIRT concluded that CALIPSO is a medium risk mission and the project concurs with this position.

Three waivers have been written by the CALIPSO project:

1) Relative to the first waiver, the NASA Safety Manual (NPR 8715.3) requires two-fault tolerance against catastrophic hazards such as the leakage of hydrazine. The CALIPSO propulsion system has five AN fittings that are zero-fault tolerant to hydrazine leakage. Consequently, a waiver was written that implements a series of supplemental safeguards that go beyond the traditional hydrazine precautions and are designed to enhance the early detection of hydrazine and thereby ensure ample evacuation time for the team. This waiver has been signed by the GSFC and LaRC Center Directors and the use of the supplemental safeguards was endorsed by KSC, JPL, and VAFB.

2) Relative to the second waiver, NASA-STD-8719.9 "Standard for Lifting Devices and Equipment" defines critical lifts as those where failure or loss of control could result in serious programmatic or institutional impact and requires periodic proof testing followed by surface nondestructive testing (NDT) to identify any cracks in critical components. CNES has a similar requirement that all critical lifts require a proof test followed by some form of surface NDT. However, CNES does not consider the lifting of the satellite to be a critical lift until the satellite is fueled. Alcatel consequently performed the required NDT on all of the vertical lifting devices but did not perform NDT on the horizontal lifting devices. Consequently, a waiver was written involving only the horizontal lifting devices that did not receive NDT. This equipment is used just once to lift the satellite from its shipping container and lower it onto the tilting dolly. After examining technical data provided by CNES and Alcatel, it was clear that the operating safety factors involved in the horizontal lifting significantly exceed NASA requirements and that the lack of NDT in this instance represented a negligible risk. The waiver was signed by the GSFC and LaRC Center Directors and the lift was subsequently performed with no difficulty.

3) Relative to the third waiver, the Missile System Prelaunch Safety Package (MSPSP) indicates that overcharging of the lithium ion battery is a catastrophic hazard and the NASA Safety Manual (NASA NPR 8715.3) requires two-fault tolerance against such catastrophic hazards. Nominal charging of this battery during the launch campaign is already two-fault tolerant and is not involved with this waiver. However, the configuration of the flight hardware and the ground support equipment for the so-called "current compensation" during the last 48 hours before launch (after fairing closeout) is only single-fault tolerant to accidental overcharging. Therefore, a waiver was written for current compensation. To mitigate the lack of two-fault tolerance during current compensation, the waiver implements six safeguards to reduce the hazard of accidental overcharging. The waiver has been reviewed and it will be approved after the safeguards are demonstrated with the satellite on the launch vehicle in launch configuration.

There were ten actions from the MRR: five of these were closed at the September Monthly Status Review, three will close before launch, and two will close post launch (Enclosure 1). Neither action planned for post launch is related to mission success: one deals with lessons learned and the other deals with a reconsideration of the overall GSFC launch Collision

Avoidance policy. All other Requests-for-Action and Non-Conformance Reports within the Project are closed.

The CALIPSO project has identified 39 residual risks that have been independently reviewed by the GSFC Office of Applied Engineering and Technology Development (AETD), the Office of Systems Safety and Mission Assurance (OSSMA), and the CALIPSO IIRT. The project and the independent assessors all agree on the consequence of each of the 39 residual risks and they also agree on the likelihood for 34 of the 39 risks. The disagreements are minimal and restricted to adjacent cells in the 5X5 matrix.

Within these 39 residual risks, the project has identified nine "yellow" risks. Of these nine risks, the project and all of the independent assessors agree on consequence and likelihood in four instances and disagree by a single level of likelihood in the remaining five risks. In two instances, the GSFC AETD and OSSMA felt that the likelihood was at the lowest level of a "red" risk. The project and the IIRT judged these to be a "yellow" risk (Enclosure 2).

The final approval of the Current Compensation Waiver is the only launch lien and will be signed in advance of the Flight Readiness Review.

CALIPSO will be launched with CloudSat from the Vandenberg Air Force Base in California no earlier than October 26, 2005. CALIPSO can launch every day at approximately 3 a.m. local time.

In summary, we conclude that CALIPSO is a medium risk mission and, pending the successful completion of the above launch lien and the other normal work, we recommend that CALIPSO proceed with launch as planned.

Edward J. Weiler

Lesa B. Roe

2 Enclosures

Goddard Program Management Council
IPMC: CALIPSO Mission Readiness Review (8/26/05)
ACTIONS

	Program/Project	Actionee	Action	Status	Date Due/ Date Closed
1	CALIPSO	Cramer/Schulz/490	For discussion at the SMARR put wording in for NFR No. 10354-Lidar Data Error to clarify that the error occurs only in STANDBY and involves only housekeeping data.	Open: The clarifications below were incorporated into the SMARR presentation for closure of this action. The anomaly summary has been reworded to: **Lidar Data Error** – Out of Sync error flag (due to incorrect buffer length) detected on Lidar FLX serial channels . The disposition summary has been expanded to: Cause unknown. Each of the four instances of this error flag occurred in STANDBY mode, causing the loss of a single frame of LRE engineering telemetry. In the event that this error ever occurs in Data Acquisition mode, only a single frame of science and engineering data would be lost. All identifiable possible causes have been studied and the overall risk has been deemed acceptable.	CLOSED – September 2005 MSR
2	CALIPSO	Cramer/Schulz 490	Resolve the role of the Solar Array Drive Mechanism (RR-25) relative to the minimum mission (3 year) within the next week with Codes 300 and 500.	Open: Meeting held with Codes 300 and 500. At the meeting Code 500 insisted that for consistency the rating had to be based on Full Mission Success (i.e., 3 year mission) versus a one year minimum mission. However, consensus was achieved with both 300 and 500 to a (2,5) rating which the Project concurs with. At the MRR, 300 and 500 rated it a (3.5).	CLOSED – September 2005 MSR
3	CALIPSO	Cramer/Schulz 490	Resolve the current medium probability for not meeting the Minimum Success Criteria for FPGA reliability within the next week.	Open: Held a meeting with Codes 300 and 500. At the meeting reach concurrence to rate risk as (2,5). Subsequently AETD team documented its risk assessment for the	CLOSED – September 2005 MSR

Attachment

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	Program/Project	Actionee	Action	Status	Date Due/ Date Closed
				FPGA and revised it to a (3,5) risk, the rating has a high degree of uncertainty. Project and Code 300 concur on (2,5) and Code 500 (3,5).	
4	CALIPSO	Cramer/Schulz/490	Reconsider the 2-2 scoring of the GLAS Failure Type 1 (RR-42) within the next week.	Open: A meeting was held with Codes 300 and 500 to discuss. At the meeting consensus was reached to revise rating from the MRR (2,4) to (2,3). Subsequently Code 300 revised their rating to a (2,4) based on the lack of an assessment of how long the laser could operate in a one bank mode. Such as assessment was performed in early 2004; estimating 11 months. The assessment and the technical rationale has been provided to Code 300 for their assessment. Project and Code 500 concur (2,3) and Code 300 (2,4).	OPEN (will be Closed at October MSR)
5	CALIPSO	Cramer/Schulz/490	Reconsider the scoring of the S/H Parts in the LRE (RR-27) within the next week.	Open: Met with Codes 300 and 500 to discuss. We learned that there are some common parts in the LIDAR that could be impacted if one of the S/H circuits fails. Based on this new information 300 and 500 felt that the consequence should be a 5, not able to meet minimum mission success, versus a 2. Project did not totally agree, but had not basis for disagreeing. Therefore, all parties converged on (2,5).	CLOSED – September 2005 MSR
6	CALIPSO	Cramer/Schulz/490	The Anomaly Management Plan must be developed and approved before launch.	Open: Anomaly management plan is contained in PC-SAT-403 NASA/CNES Mission Management Plan. The plan is under review by both NASA and CNES and scheduled to be approved by 9/16/05.	OPEN (will be closed prior to FRR)

Goddard Program Management Council
IPMC: CALIPSO Mission Readiness Review (8/26/05)
ACTIONS

	Program/Project	Actionee	Action	Status	Date Due/ Date Closed
7	CALIPSO	Scott/170/500	Within six months after the launch of CALIPSO/CloudSat, produce a Knowledge Management Lessons Learned Course and Panel Discussion on the CALIPSO mission as has been done or is planned for other complex missions with valuable lessons learned. Include GQ, GSFC, LaRC, and CNES in the Lessons Learned and Panel discussions if practical in order to ensure a balanced perspective.	Open: Project will work with Code 170 t6o collect lessons learned during the development of the Calipso mission to help future foreign partnership missions to be less risky and problematic.	OPEN (will be Closed Post-Launch)
8	CALIPSO	Scott/170/500	Determine whether the GSFC Launch COLA (Collision Avoidance) Policy is too stringent and impractical to permit a CALIPSO/CloudSat launch given the complexities and constraints of this co-manifested mission. Determine whether a waiver to the GSFC Launch COLA Policy is required/advisable for this mission.	Open: Per a September 8, 2005 telecon discussion with the KSC, GSFC, and WFF personel, Code 170 is considering a slight modification to the **GSFC Satellite** COLA by limiting the collective risk of collision (that would block a particular launch day) to a maximum threshold of 3x10E-5 per attempt, exactly as stated in the GSFC Launch Collision Avoidance Policy. This would mean that a single incident of greater than 1x10E-6 would not necessarily trigger a launch scrub, provided the sum of the probabilities met the collective requirement. This recommended change will require a waiver.	OPEN (will be closed prior to FRR")
9	CALIPSO	Scott/170/500	Re-examine the GSFC Launch COLA Policy to determine whether it is too stringent, impractical, expensive, and has too large an associated uncertainty (error bars) to continue to implement or if it is a rational and practical approach to implementing NASA Requirements and International Agreements on collision avoidance, orbital debris, orbital contamination, and safety.	Open: Code 170 to start working this with KSC in conjunction with MRR AI#8. Will continue to work after launch to make sure that it is consistent with agency policy.	OPEN (will be closed Post-Launch)

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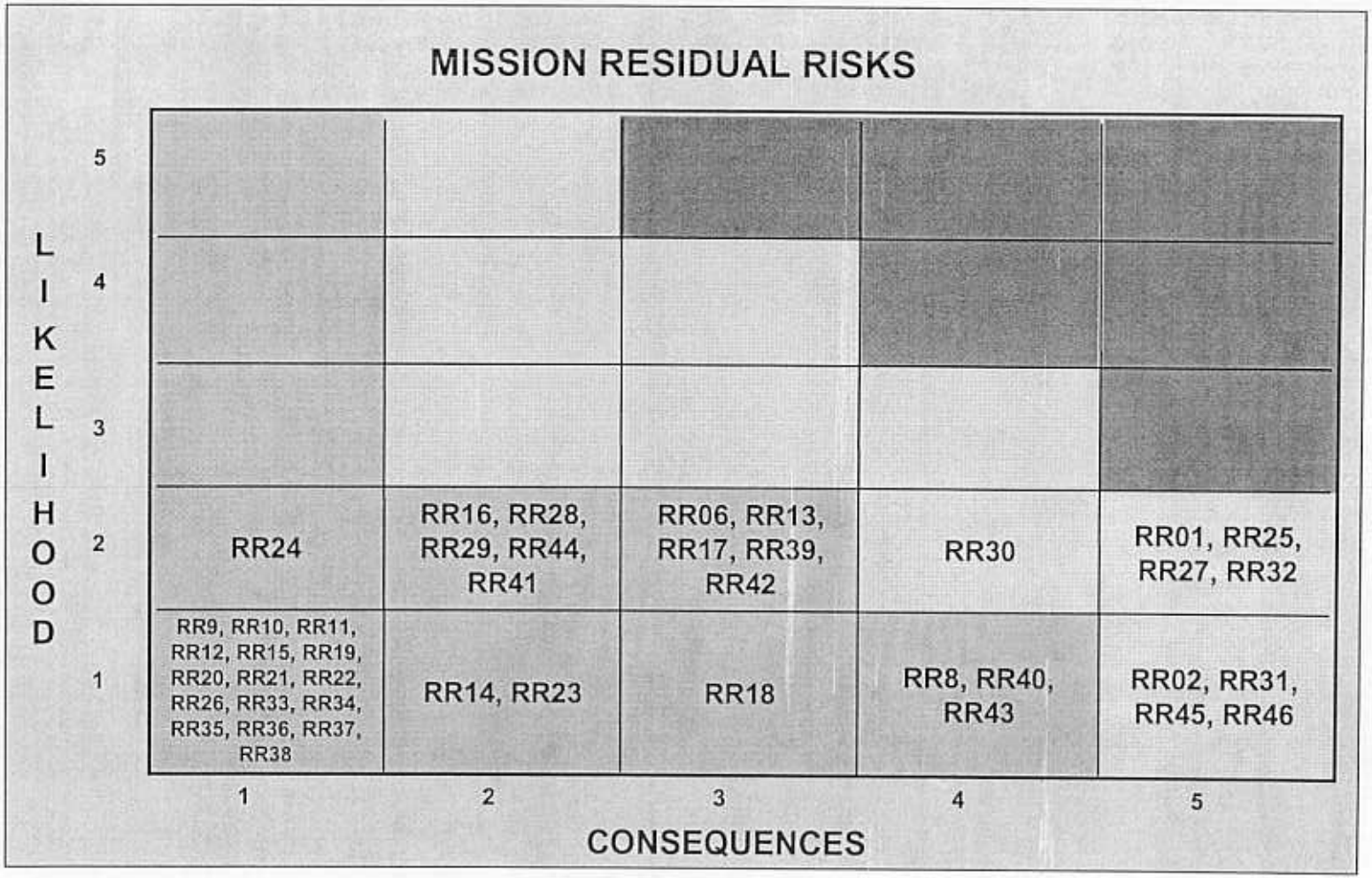
10	CALIPSO	Mitskevich/KSC	KSC to schedule a tentative VITS with Goddard and Langley regarding the progress on the FTS batteries (September 6 ERB) and the 2nd Stage Tanks (September 7 ERB), prior to the Launch Site Readiness Review that is currently scheduled for September 8. VITS will be held if there is not a clear path to proceeding with the LSRR.	Open: KSC allowed us to participate in the three ERBS that have been held to date. The outcome of all three was a recommendation to proceed to the LSRR. Therefore, a VITS meeting was not required.	CLOSED – September 2005 MSR

CALIPSO Residual Risk Summary

ESSP / CALIPSO

8-31-05



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CALIPSO Project Yellow Risks

F= Flight Hardware and/or Facilities M = Mission Success P = Personnel Residual Risk		Project SMA	
RR-01-P	Hydrazine Leakage - Personnel	1, 5	RR01
RR-01-F	Hydrazine Leakage - Flight Hardware	2, 5	
RR-01-M	Hydrazine Leakage - Mission Assurance	3, 3/2, 5	
RR-02-P	Excessive Battery Charge - Personnel	1, 5	RR02
RR-02-F	Excessive Battery Charge - Flight Hardware	1, 5	
RR-02-M	Excessive Battery Charge - Mission Success	1, 5	
RR-25-M	Use of SADM Without Life Test	2, 5	RR25
RR-27-M	Sample-and-Hold Chips	2, 5	RR27
RR-30-M	Incorrect Installation of Polarized Capacitors	2, 4	RR30
RR-31-M	220V Short to Satellite Ground	1, 5	RR31
RR-32-M	FPGA Controlling the Laser	2, 5	RR32
RR-45-M	Defective Staking on Ball Procduced PC Boards	1, 5	RR45
RR-46-P	Procedural Errors during Final Pressurization	1, 5	RR46